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Jacobson et al.

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(54) **SYSTEM FOR PROVIDING LOCATION
BASED SERVICE TO A WIRELESS
TELEPHONE SET IN A TELEPHONE
SYSTEM**

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* cited by examiner

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(57) **ABSTRACT**

A system for providing location based service telephone call to wireless subscribers. The system of the present invention provides processes for receiving location data about a wireless subscriber telephone and using the information to find the telephone number of the nearest service provider. The wireless subscriber telephone set can then be connected to the nearest service provider. It is also possible to a plurality of different location identifiers to determine the nearest service provider. In performing a look-up, the list can be used on a priority basis to determine the nearest service provider.

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(52) **U.S. Cl.** **455/456**

(58) **Field of Search** 455/456, 404,
455/403, 517, 445, 521, 412, 422, 414;
342/357.01, 357.08, 457, 357.14

(56) **References Cited**

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13 Claims, 5 Drawing Sheets

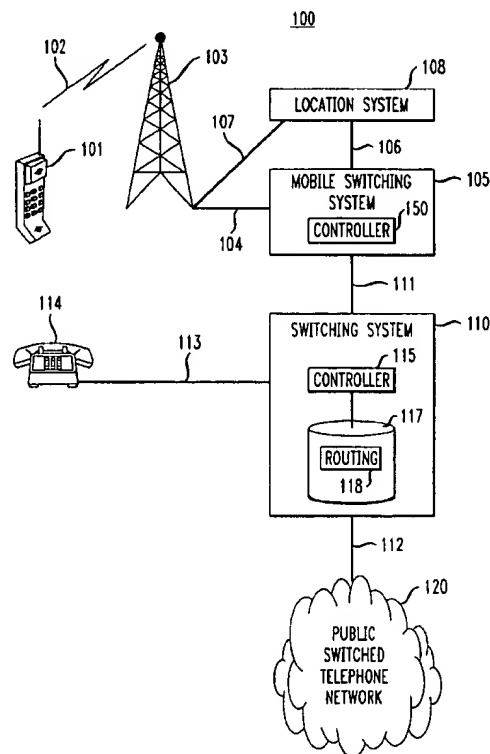


FIG. 1

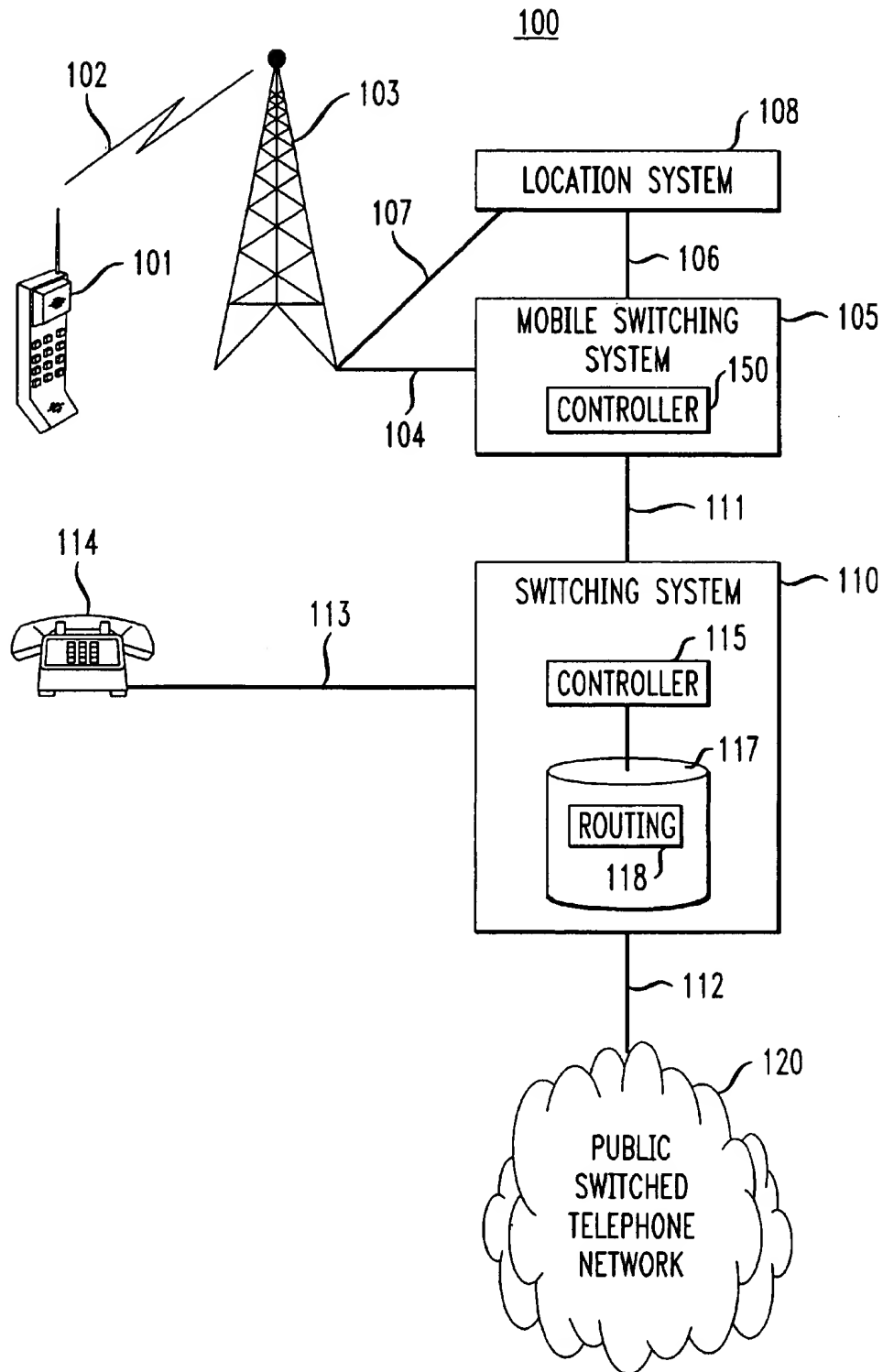


FIG. 2

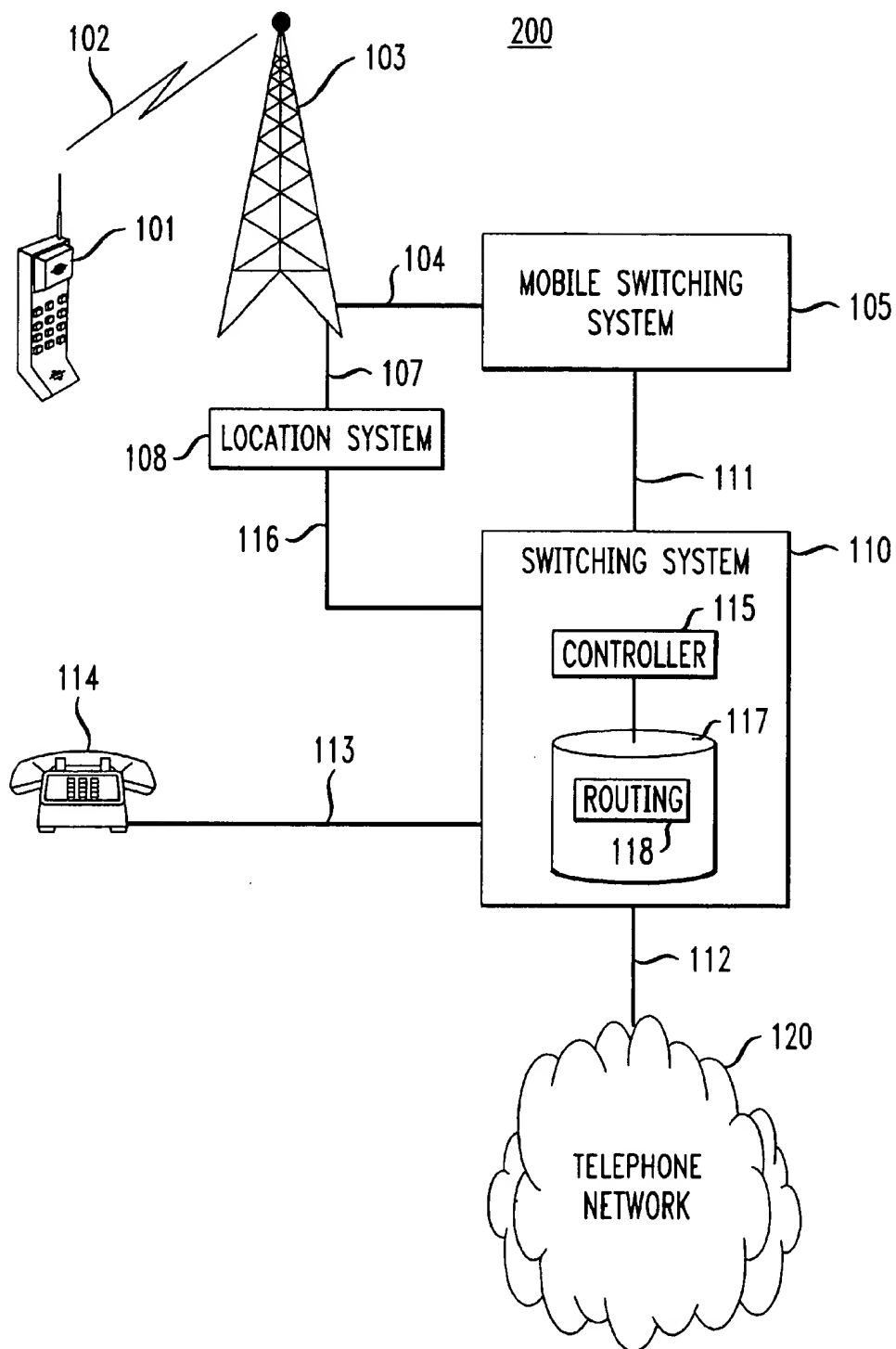


FIG. 3

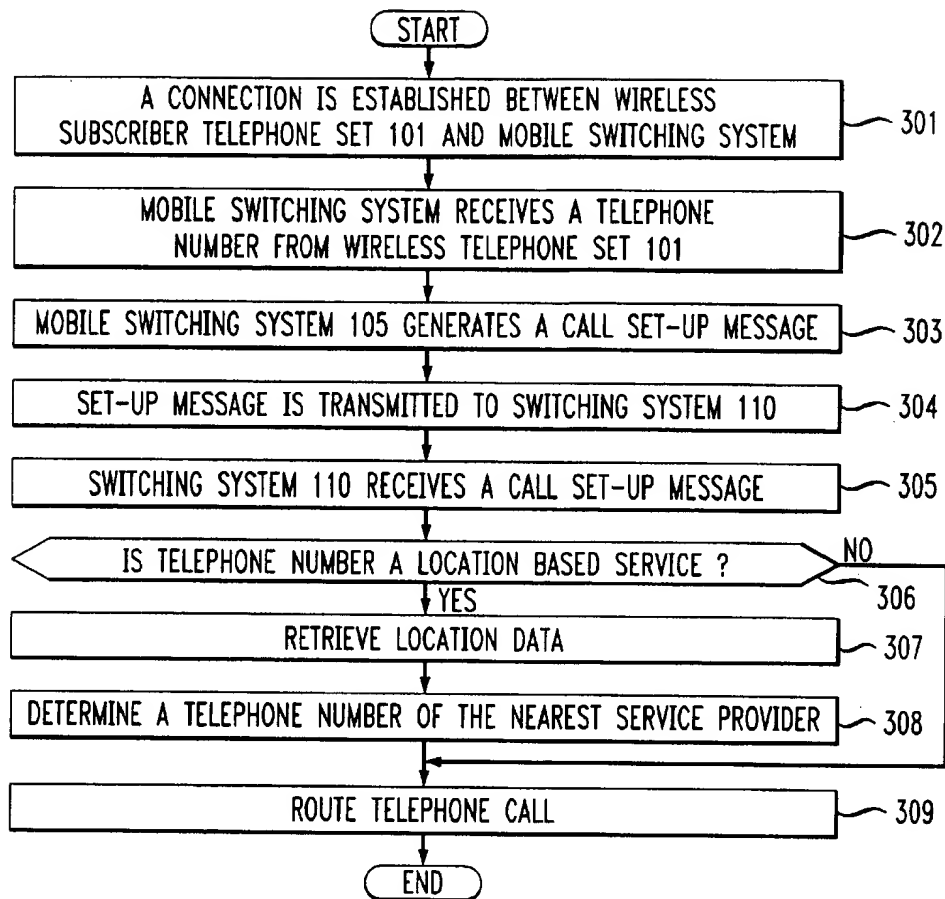


FIG. 4

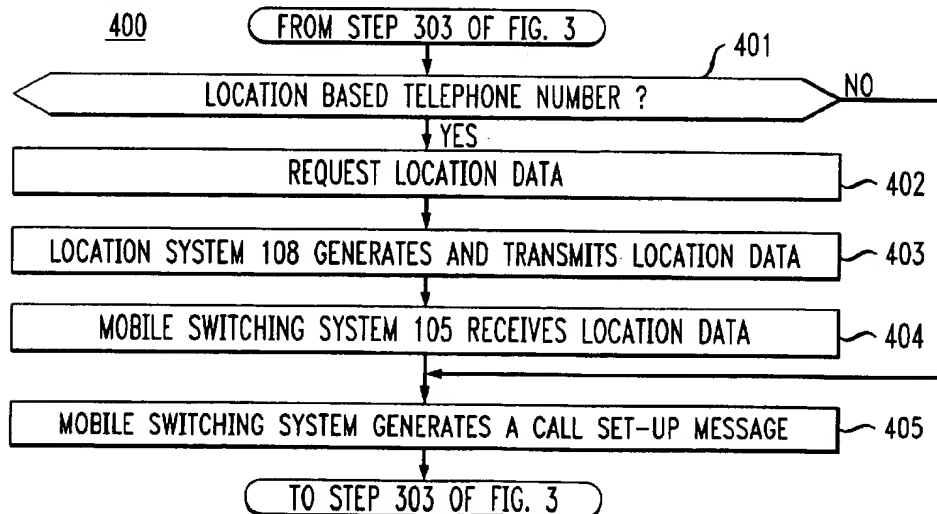


FIG. 5
500

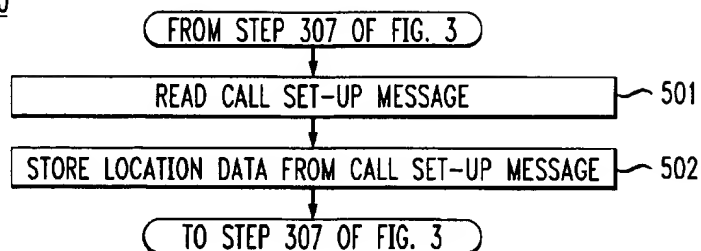


FIG. 6
600

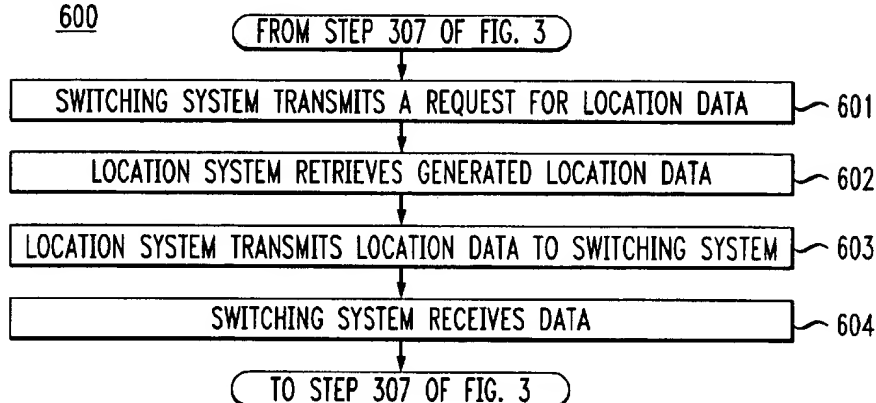


FIG. 7

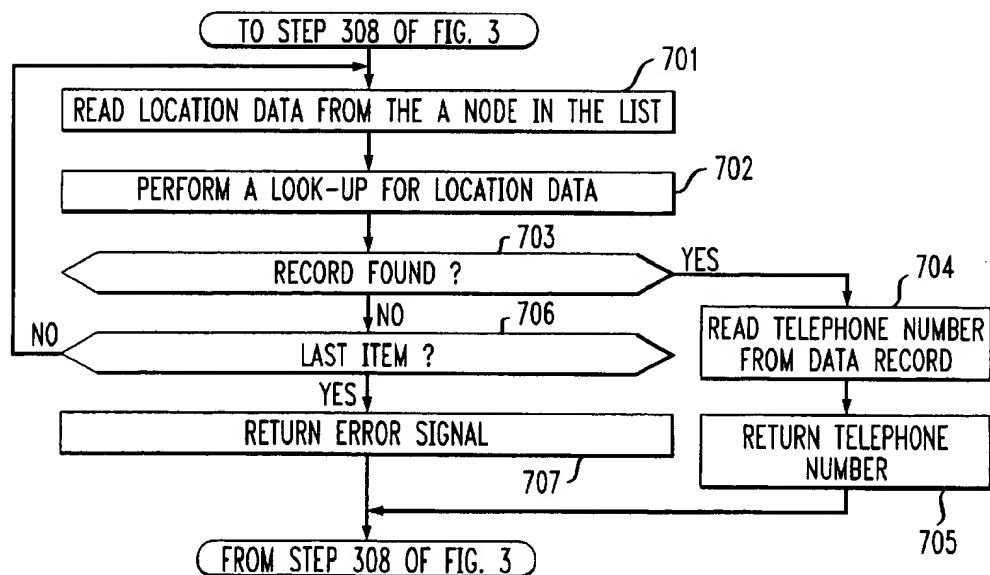


FIG. 8

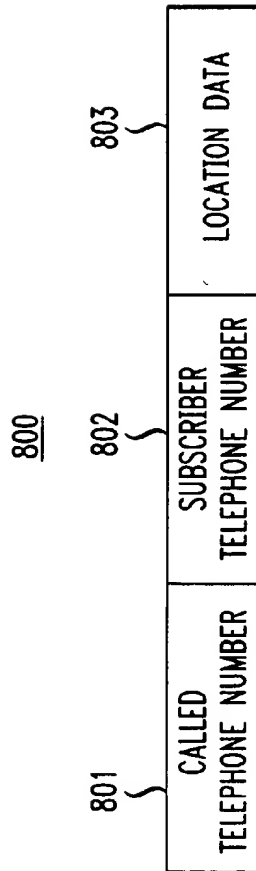
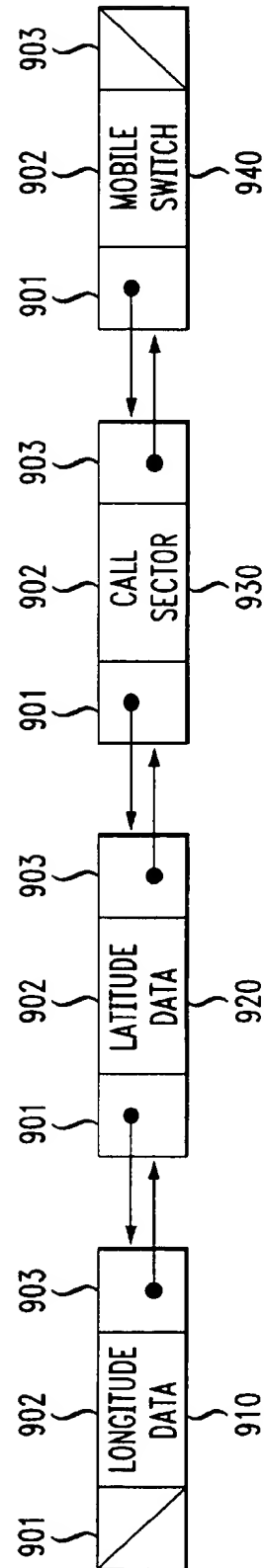


FIG. 9



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SYSTEM FOR PROVIDING LOCATION BASED SERVICE TO A WIRELESS TELEPHONE SET IN A TELEPHONE SYSTEM

FIELD OF THE INVENTION

This invention relates to extending a telephone call from a wireless telephone set to a location based service provider based upon the location of the wireless telephone. More particularly, this invention relates to a process for determining a location service provider that provides service to the location of the wireless telephone set and extending the telephone call to that location based service provider.

PROBLEM

It is a problem to provide location based telephone service to a wireless telephone set. Location based telephone service is the extending of a telephone call from the caller to a service provider serving the area from which the telephone call is being placed. Some examples of location based telephone services are a 911 emergency telephone service and a toll-free telephone number for a franchise that connects a caller to the nearest outlet of the franchise serving the subscriber. The difficulty in providing a location based service to a wireless telephone is determining which service provider provides service to the location of the wireless telephone set. The determination of the nearest provider is typically not a problem for a telephone call placed from a non-wireless telephone set. One common method for determining the location based service provider that should receive a call from a non-wireless telephone line is to simply extend the call to the service provider that is connected to the same central office switching system as the calling party telephone line. Another common method is to connect the caller to a service provider based upon a prefix in the telephone numbers of the callers and the location based service providers. Finally, it is also possible to maintain a database which stores a street address associated with each telephone number and to use the database to determine the service provider servicing the caller's telephone number based upon the street address of the caller.

The solutions for extending location based service calls from a non-wireless set are not feasible for a telephone call placed from a wireless telephone set. Wireless telephones are mobile and a wireless caller may place a telephone call from anywhere in the caller's area of coverage. The above methods for extending non-wireless telephone calls rely upon the fact that non-wireless telephones are not mobile and can easily be associated with one location which is not true for a wireless telephone set.

A telephone call from a wireless telephone is connected to the called party in the following manner. The wireless caller dials a telephone number. The wireless telephone set transmits radio signals to a cellular antenna that serves the sector from which the caller is calling. A connection over an available radio frequency band is then established between the telephone set and the antenna. A mobile switching system that provides telephone service for the wireless telephone receives and transmits radio signals to the wireless telephone via the antenna. The mobile switching system connects the wireless telephone network to the public telephone switching network. In order to establish a telephone connection, the mobile switching system generates a call set-up message, which includes the wireless telephone number of the caller and the telephone number that the called party. The call set-up message is then transmitted to a

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non-wireless public switching system which establishes a connection to the called party. The problem in providing location based services is that there is no way to determine the location of a wireless telephone set placing a location based telephone call from the call set-up message. There is a need for a system that can provide the location of a wireless telephone set placing a telephone call and extend the telephone call to the location based service provider that provides service to that location.

SOLUTION

The above and other problems are solved and an advance in the art is made by the present invention. The present invention provides location based services to a wireless telephone set. The present invention first determines the location of the wireless telephone set and then uses the location of the telephone set to determine which location based service provider provides service to the location. The telephone call is then extended to the determined location based service provider.

In a first preferred exemplary embodiment of this invention, a wireless location system is connected to the mobile switching system. A telephone call to a location based service from a wireless telephone set is completed in the following manner. A wireless telephone establishes a radio connection to an antenna and transmits a location based telephone number to the antenna. The antenna transmits the location based telephone number to the mobile switching system. Upon receiving the location based telephone number, the mobile switching system transmits a request for location data about the wireless telephone set to the connected location system. The location system determines the location of the wireless telephone set, generates the location data, and transmits the location data for the wireless telephone set to mobile switching system. The mobile switching system receives the location data and then generates a call set-up message that includes the location data. The call set-up message is transmitted to a connected non-wireless public switching system. The public switching system then performs a look-up routine in a location based service provider database using the location data from the call set-up message to determine the location based service provider that provides service to the location of the caller. The telephone call is then extended to the location based service provider.

In a second exemplary embodiment, the wireless location system is connected to a public switching system. Location based wireless telephone calls are completed in the following manner. An antenna receives a telephone call placed to a location based telephone number from a wireless telephone set. The antenna establishes a connection with a mobile switching system. The mobile switching system generates a call set-up message for a connection to the location based service and transmits the message to a connected non-wireless public telephone switching system. The call set-up message includes the telephone number of the wireless calling party and the telephone number of the location based telephone service.

When the public switching system receives the call set-up message, the system recognizes the called telephone number as a location based telephone number and the calling number as a wireless telephone set. The switching system then requests location data for the wireless telephone set from a wireless telephone location system. The wireless telephone location system uses radio signals transmitted between the wireless telephone and antenna to determine the location of

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the wireless telephone set and to generate location data which is transmitted to the switching system. The switching system uses the location data to perform a look-up routine in a service provider database to determine the location based service provider that provides service the location of the caller. The switching system then extends the telephone call to the determined service provider.

DESCRIPTION OF THE DRAWINGS

The present invention can be understood by reading the following detailed description in conjunction with the following drawings:

FIG. 1 illustrating a block diagram of one possible embodiment of components of a telephone system needed to provide wireless location based telephone service;

FIG. 2 illustrating a block diagram of a second possible exemplary embodiment of components needed to provide wireless location based telephone service;

FIG. 3 illustrating a flow diagram of a process for providing wireless location based services;

FIG. 4 illustrating a flow diagram of a process for generating a call set-up message in a first exemplary embodiment;

FIG. 5 illustrating a flow diagram of a process for retrieving location data in a first exemplary embodiment;

FIG. 6 illustrating a flow diagram of a process for retrieving location data in a second exemplary embodiment;

FIG. 7 illustrating a flow diagram of a process for using a priority list of location data to determine a location based provider nearest to a caller;

FIG. 8 illustrating a data packet of a call set-up message; and

FIG. 9 illustrating a data structure of a priority list of location identifications for the caller.

DETAILED DESCRIPTION

Components of a Telephone Network for Providing Location Based Wireless Service—FIG. 1

FIG. 1 illustrates the components of telephone system 100 that provide location based services to a wireless caller telephone set 101. Radio Frequency (RF) signals 102 are transmitted between wireless caller telephone set 101 and antenna 103 to establish a connection between telephone set 101 and telephone network 100. Antenna 103 is connected to mobile switching system 105 via path 104. Mobile switching system 105 is a switching system that is connected to a plurality of antenna 103 to provide telephone service to a plurality of wireless caller telephone sets 101. Mobile switching system 105 has a controller 150 which comprises a processing unit for performing the functions of providing telephone service to wireless caller telephone sets 101. The provision of wireless telephone service by mobile switching system 105 is well known to those skilled in the art and is not discussed herein.

A location system 108 is connected to antenna 103 via path 107. Location system 108 is a system that can determine the location of wireless telephone set 101 by monitoring the RF signals 102 received by antenna 103 from wireless telephone set 101. Controller 180 is a processing unit that executes the processes for determining the location of wireless caller telephone set 101 in location system 108. The process for determining the location of telephone set is well known to those skilled in the art and is not discussed in detail.

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Mobile switching system 105 provides a connection for wireless telephone set 101 to non-wireless public switched telephone network 120 via switching system 110. Switching system 110 and mobile switching system 105 are connected by trunk 111 to complete telephone calls between wireless callers and non-wireless callers. An example of a common switching system 110 is a 5 ESS central office switching system manufactured by Lucent Technologies. Controller 115 is a processing unit in switching system 110 which executes the required processes needed for switching system 110 to provide telephone service. Non-volatile memory 117 is a tape or disk drive capable of storing information on a storage media for a long period of time. Non-volatile memory 117 is used by controller 115 to store databases and other data needed to provide telephone service including the wireless location based services of the present invention. In order to provide location based services, memory 117 stores service provider database 118. Service provider database 118 is a database containing location data and area of coverage for the various service providers.

Switching system 110 is connected to public switched telephone network 120 via communication path 112. Communications paths 112 is representative of a plurality of trunks connecting switching system 110 to other switching systems in public switched network 120. Path 113 is representative a loop connecting a telephone station 114 to switching system 110. For purposes of the present discussion, telephone station 114 is associated with a telephone number that provides location based telephone services to callers. Location based telephone services are those services in which an incoming telephone call is extended to a service provider that provides service to the location of the caller placing the telephone call. It is also possible that a location based service provider may be connected to another switching system in network 120 in which case the call would be extended to the other switching system via a trunk in path 112.

Alternative Configuration of Components for Providing Wireless Location Based Services—FIG. 2.

Telephone system 200, illustrated in FIG. 2, is alternative second alternative exemplary embodiment in which location system 108 is connected to switching system 110 via communications path 116. This allows data to be transferred between location system 108 and switching system 110. The configuration of telephone system 200 allows location system 108 to calculate the location of wireless telephone set 101 while a call set-up message is being generated and transmitted from mobile switching system 105 to switching system 110. The switching system 110 requests the location information when needed. This avoids a delay in generating the call set-up message to wait for the location information to be received and avoids undue delays in routing the telephone call.

An Operational Overview of a Process for Providing Location Based Services to a Wireless Caller—FIG. 3

FIG. 3 illustrates an operational overview of a process for providing location based services to a wireless caller. Depending upon which of the two above described configurations are used to provide location based service, the manner in which these steps are performed varies. For either configuration, the location data is a priority list (shown in FIG. 9) containing a plurality of different location identifiers

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or call routing parameters that can be used to determine the service provider that should receive the telephone call.

Process 300 begins in step 301 with a connection being established between wireless caller telephone set 101 and mobile switching system 105 via RF signals 102 and antenna 103. In response to a connection being established, a dial tone is transmitted to wireless caller telephone set 101. The caller is then able to dial a number. In step 302, mobile switching system 105 receives the dialed number from wireless telephone set 101.

Mobile switching system 105 generates a call set up message in step 303. A call set-up message is a request by mobile switching system 105 to establish a connection with a telephone line of the called telephone number. If location system 108 is connected to mobile switching system 105, process 400 illustrated in FIG. 4 can be used to generate the call set-up message. Otherwise, the call set-up message is generated in a standard manner and in a standard protocol such as SS7, that is well understood by those skilled in the art. Mobile switching station 105 transmits the generated call set-up message to switching system 110 in step 304 and in step 305, switching system 110 receives the call set-up message.

After receiving the call set-up message, switching system 110 determines if the telephone number is for a location based service in step 306. If the telephone number is not for a location based service, process 300 proceeds directly to step 309 and the telephone call is extended to the telephone number in the call set-up message. If the telephone number is for a location based service, the location data for wireless telephone set 101 is retrieved in step 307. The retrieval process is dependent upon the embodiment of the invention in used to provide location based services. If the first exemplary embodiment is used, process 500, illustrated in FIG. 5, retrieves the location information. If the second preferred exemplary embodiment is used, process 600, illustrated in FIG. 6, retrieves the information. In step 308, the location information retrieved is used to determine the telephone number of the location based service provider that provides service to the location is determined. The telephone call is then routed to the location based service provider that provides service to the location of the caller in step 309.

A Process for Generating a Call Set-up Message in a First Preferred Embodiment—FIG. 4.

In a first embodiment of the present invention (shown in FIG. 1), telephone network 100 has location system 108 connected to mobile switching system 105. In order to provide location based services, mobile switching system 105 must transmit location data received from location system 108 to switching system 110. Process 400, illustrated in FIG. 4, generates a call set-up message which contains the location information for wireless telephone set 101.

Process 400 begins in step 401 with mobile switching system 105 determining if the received called telephone number is a location based service telephone number. If the telephone number is not a location based service telephone number, process 400 proceeds directly to step 405 and generates a standard call-step message. If the number is a location based telephone number, mobile switching system 105 transmits a request to location system 108 for location data of wireless caller telephone set 101.

Location system 108 receives the request and compiles the location data for wireless telephone set 101 in step 402. The location data may include the following different types of location identifiers or call routing parameters for a

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wireless telephone set 101: a longitudinal and latitudinal location of telephone set 101, the cellular sector from which wireless telephone set 101 is transmitting, and the mobile switching system 105 that is providing telephone service to wireless telephone set 101. Location system 108 then transmits this location data to mobile switching system 105 in step 403.

In step 404, mobile switching system 105 receives the location data from location system 108. The location data is then used to generate a call set-up message for a location based call in step 405. The call set-up message can be a packet of digital data representing a plurality of bit fields as illustrated in FIG. 8. Packet 800 has a message type identification field 801, a calling party identification field 802, a called party field 803, a command parameter field 804 storing a command indicating the call is to a location based service, and a data field 803 for the location data. After the call set-up message is generated, process 400 then ends by returning to step 302 of FIG. 3.

Processes for Retrieving Location Data—FIGS. 5 and 6.

The processes for retrieving location data in step 307 of FIG. 3 is illustrated for the two different embodiments in FIGS. 5 and 6. In the first embodiment (shown in FIG. 1), the location data for wireless telephone set 101 is transmitted in a call set-up message to switching system 110 and process 500 must be used to retrieve the location data from the call set-up message. In the second embodiment (shown in FIG. 2), location system 108 is connected to switching system 110 and receives the location data from location system 108. Process 600 is illustrated in FIG. 6 and retrieves the location information from location system 108.

Process 500 is illustrated in FIG. 5 and retrieves location data transmitted from mobile switching station 105 to switching system 110 in a call set-up message. Process 500 begins in step 501 with switching system 110 reading the call set-up message 800. In step 502, switching system 110 stores the information in field 803 which is the location data. The location data may be comprised of data as simple as the identity of mobile switching system 105, or as complex as the a call routing list described below in FIG.9. Process 500 then returns to step 307 of FIG.3.

Process 600 is illustrated in FIG.6 and is the process used in a second embodiment (shown in FIG. 2) to retrieve the location data. In the second embodiment, location system 108 is connected to switching system 110. This allows location system 108 to compile the location data for wireless telephone 101 at the same time that a call set-up message is being generated and transmitted to switching system 110. The only time the location system is accessed is when location data is needed. This prevents a delay in the call set-up while mobile switching system 105 must wait to generate the call set-up message until the location data is generated.

Process 600 begins in step 601 in which switching system 110 transmits a request to location system 108 for location data of wireless telephone set 101. In step 602, location system 108 retrieves the location information for the request wireless telephone set 101. The location data can include the priority list in FIG. 9 or can be any other type of identity for the position of wireless telephone set 101 with respect to the service providers. In step 603, the location data is transmitted to switching system 110. Switching system 110 receives the transmitted data in step 604 and process 600 is completed by returning to step 307 of FIG. 3.

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Process for Determining the Telephone Number of
the Nearest Service Provider Based upon Location
Data in a Priority List—FIG. 7.

Either embodiment of the present invention can provide location data in a priority list as illustrated in FIG. 9 that is used by process 700, illustrated in FIG. 7, to determine the telephone number of the nearest service provider. Priority list 900 illustrated in FIG. 9 is a list of location identifiers called call routing parameters. The call routing parameters in list are ordered in a manner that an application performing process 700 expects to receive the call routing parameters. Although priority list 900 is described as a list it be contained in a message packet as consecutive groups of data.

Priority list 900 is comprised of nodes 910, 920, 930, and 940. Each node also contains one type of location data. In the illustrated priority list 900, node 910 contains longitudinal position data for wireless telephone set 101, node 920 contains latitudinal position data for wireless telephone set 102, node 930 contains the calling cellular sector of wireless telephone set 101, and node 940 contains the identity of mobile switching system 105 that is providing telephone service to wireless telephone set 101.

FIG. 7 illustrates a process 700 that goes through the information in the nodes of list 900 and attempts to determine the telephone number of the service provider from the location data in each node. One possible use for this type of search is if different types location systems that generate different kinds of location data are connected to the mobile switching systems. The different kinds of data could be placed in different nodes. A switching system could then read the nodes until data is found. The parameter list may be used to widen the scope of a search when data about the specific location of a wireless telephone does not produce a service provider. In this case, another parameter containing more generalized information may be used.

Process 700 begins in step 701 with switching system 100 reading location data from a node. In step 702, switching system 110 attempts to find a data record in a routing database for the location data from a node. In step 703, it is determined whether the a data record for the location information was found. If a data record was found in step 703, the telephone number is read in step 704 and the telephone number is returned in step 705. If a data record was not found, it is determined if the current node is the last node in the list in step 706. If the node is the last node an error signal is return in step 707. Otherwise, process 700 is repeated starting from step 701.

The above is a description of two exemplary preferred embodiments of a system for providing location based service to a wireless caller. Those skilled in the art can and will design other embodiments of the wireless location based service system that infringe on the following claims either literally or through the Doctrine of Equivalents.

What is claimed is:

1. A system for automatically connecting a wireless telephone set to an automatically selected one of a plurality of location based service providers comprising:

means for receiving a request from a wireless telephone set to establish a communication connection between said wireless telephone set and a called party comprising a telephone system of a location based service provider that provides a service to subscribers located in a predefined service area;

means, responsive to receiving said request, for determining a present location of said wireless telephone set;

means, responsive to determining said location of said wireless telephone set, for identifying a telephone num-

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ber of a telephone system of the one of said plurality of location based service providers that provides said service to said present location of said wireless telephone set; and

means, responsive to identifying said telephone number of a telephone system of said one of said plurality of location based service providers, for establishing said communication connection between said telephone system of said one of said plurality of location based service providers and said wireless telephone set.

2. The system of claim 1 further comprising:

means for establishing a radio frequency connection with said wireless telephone set;

means for generating said request responsive to receiving a telephone number that identifies a service from said wireless telephone set; and

means for transmitting said request to said means for receiving.

3. A system for automatically connecting a wireless telephone set to an automatically selected one of a plurality of location based service providers comprising:

a switching system that provides telephone service to a wireless telephone set;

a wireless telephone set locating system that determines a present location of said wireless telephone set;

a location based call routing database in said switching system for maintaining records of a plurality of location based service providers, each of which provide a service to subscribers located in a predefined service area, locations serviced by said location based service providers, and the telephone number of a telephone system serving each of said location based service providers;

a first software application executed by said switching system responsive to a request from said wireless telephone set to establish a communication connection between said wireless telephone set and a called party comprising a telephone system of a location based service provider that provides a service to subscribers located in a predefined service area for receiving data indicative of a present location of a wireless telephone set from said wireless telephone set locating system, for reading said location based call routing database to determine a telephone number identifying a telephone system of the one of said plurality of location based service provider that provides service to said present location of said wireless telephone set, and for establishing a communication connection from said wireless telephone set to said telephone system of the one of said plurality of location based service providers that provides service to said present location of said wireless telephone set.

4. The system of claim 3 further comprising:

a mobile switching system connected to said switching system;

said wireless telephone locating system being connected to said mobile switching system; and

a second software application executed by a controller in said mobile switching system for generating a call set up message including said that identifies said service and transmitting said call set up message to said switching system.

5. The system of claim 4 wherein said mobile switching system is connected to said wireless telephone locating system and said wireless telephone locating system further comprises:

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means for transmitting location data of said wireless telephone set to said mobile switching system wherein said call set up message includes said location data.

6. The system of claim 5 wherein said first software application reads said location data from said call set up message and reads said location based service provider database to determine said location based service provider that provides a service to subscribers located in a predefined service area.

7. The system of claim 3 wherein said first software application transmits a location request to said wireless telephone locating system responsive to receiving a telephone number that identifies a service, receives said location data responsive to transmitting said location request and uses said location data to find said location based service provider that provides service for said location using said service provider database.

8. A method for automatically connecting a wireless telephone set to an automatically selected one of a plurality of location based service providers comprising the steps of:

receiving a request from a wireless telephone set to establish a communication connection between said wireless telephone set and a called party comprising a telephone system of a location based service provider that provides a service to subscribers located in a predefined service area;

detecting a present location of said wireless telephone set; identifying a telephone number of a telephone system of the one of said plurality of location based service providers that provide said service to said present location of said wireless telephone set; and

establishing a communication connection from said wireless telephone set to said telephone system of the one of said plurality of location based service providers that provides said service responsive to determining said location based service provider.

9. The method of claim 8 further comprising the steps of: receiving a telephone number that identifies a service in a mobile switching system; generating said request for said communication connection in said mobile switching system; and

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transmitting said request from said mobile switching system to a public switching system.

10. The method of 9 further comprising the steps of: transmitting a request for location data from said mobile switching system to a location system in response to receiving said telephone number that identifies a service;

generating said location data in said location system; transmitting said location data to said mobile switching system;

receiving said location data in mobile switching system; and

said step of generating said request being responsive to receiving said location data and said request includes said location data.

11. The method of claim 10 further comprising the steps of:

reading said location data from said received request.

12. The method of claim 8 further comprising the steps of: transmitting a location request for location data for said wireless telephone set to a location system responsive to receiving said request;

determining said location of said wireless telephone set in said location system responsive to receiving said location request;

generating location data for said wireless telephone set responsive to determining said location; and

said step of identifying a telephone number of a telephone system of the one of said plurality of location based service providers for said location being responsive to generating said location data.

13. The method of claim 12 wherein said step of identifying a telephone number of a telephone system of the one of said plurality of location based service providers comprises the step of:

reading a location based service provider database to determine said location based service provider from said location data.

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